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| APPLICATION NO.           | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---------------------------|-------------|----------------------|---------------------|------------------|
| 10/670,660                | 09/24/2003  | Yongsik Yu           | NOVLP078/NVLS-2856  | 8362             |
| 22434                     | 7590        | 02/24/2005           | EXAMINER            |                  |
| BEYER WEAVER & THOMAS LLP |             |                      | KESHAVAN, BELUR V   |                  |
| P.O. BOX 70250            |             |                      | ART UNIT            |                  |
| OAKLAND, CA 94612-0250    |             |                      | PAPER NUMBER        |                  |
|                           |             |                      | 2823                |                  |

DATE MAILED: 02/24/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

**Application No.**

10/670,660

**Applicant(s)**

YU ET AL.

**Examiner**

Belur V. Keshavan

**Art Unit**

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 24 September 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-31 is/are pending in the application.
- 4a) Of the above claim(s) 18-31 is/are withdrawn from consideration.
- 5) ☐ Claim(s) 1-7 and 17 is/are allowed.
- 6) ☒ Claim(s) 8 and 10-12 is/are rejected.
- 7) ☐ Claim(s) 9 and 13-16 is/are objected to.
- 8) ☒ Claim(s) 1-31 are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 24 September 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>12/15/04, 12/16/04</u> . | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Election/Restrictions*

Restriction to one of the following inventions is required under 35 U.S.C. 121:

- I. Claims 1-17, drawn to device, classified in class 257 subclass 751
- II. Claims 18-31, drawn to method, classified in class 456 subclass 667.

The inventions are distinct, each from the other because of the following reasons:

Inventions of Group I and Group II are related as product made and process of making the product respectively.

The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)).

In the instant case, in claim 20, copper diffusion barrier layer can be formed by sputter deposition technique instead of plasma enhanced chemical vapor deposition technique.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

During a telephone conversation with Mr. James E. Austin on 01/28/2005 an election was made without traverse to prosecute the invention of Group I, claim 1-17. Affirmation of this election must be made by applicant in replying to this Office action. Claims 18-31 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

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Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

#### **EXAMINER'S AMENDMENT**

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Mr. Roger S. Sampson on 02/03/2005 when the following amendments and the indication of the allowability of the application were discussed.

The application has been amended as follows:

#### ***To Claims***

Cancel non-elected claims 18-31.

In claim 13, line 1 delete "claim 1" and substitute --claim 8--.

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 8, 10, 11 and 12 are rejected under 35 U.S.C. 102(b) as being anticipated by Russell et al (US. Pub. 2002/00024117).

Regarding claims 8, 10, Russell et al. disclose in figure 1 a partially fabricated semiconductor device (8) comprising: a metal interconnect (12) formed substantially of copper (column 4 and line 44); and a copper diffusion barrier (18) adjacent the metal interconnect wherein the copper diffusion barrier is formed of a silicon based material comprising a compound selected from the list comprising silicon nitride and silicon carbide doped with boron (column 4 and line 32).

Regarding claims 11 and 12, Russell et al., in column 4 and lines 26-35, disclose where in copper diffusion barrier further comprising a first layer of boron doped silicon nitride or boron doped silicon carbide and a second boron doped layer comprising silicon and one or more elements selected from the list of elements consisting of carbon, nitrogen and oxygen.

***Allowable Subject Matter***

Claims 9 and 13-16 are objected to as being dependent upon a rejected base claim but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 1-7 and 17 are allowed.

***Examiner's Statement As To The Reasons For The Allowance***

The following is a statement of reasons for allowance:

The disclosure is related to a low dielectric constant copper diffusion barrier film formed of a silicon based material doped with boron.

The primary reason for the indication of the allowability of claims 1-7 and 17 is the inclusion therein, in combination as currently claimed, of the limitation comprising inter alia the following limitations: a copper diffusion barrier film formed of a silicon based material doped with boron and maintaining a stable dielectric constant of less than 4.5 in the presence of environmental moisture (claims 1); a copper diffusion barrier film comprising a first film of boron nitride or silicon boron nitride and a second layer comprising boron and one or more elements selected from the elements consisting of silicon, carbon, nitrogen and oxygen, where in the copper diffusion barrier film maintains a stable dielectric constant of less than 4.5 in the presence of atmospheric moisture (claim 17). The limitations found in claims 1-17 are neither disclosed nor taught by the prior art of record alone or in combination.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Belur V. Keshavan whose telephone number is 571-272-1894. The examiner can normally be reached on 8-4:30 Monday to Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew S. Smith can be reached on 571-272-1907. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

BVK. *BVK*  
February 12, 2005.

Belur V. Keshavan. *2823*  
Examiner. Art Unit ~~2825~~.

*Olik Chaudhuri*  
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